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ANTECEDENTS AND BARRIERS TO SUSTAINABLE FOOD WASTE PRACTICES AMONG LOWER-MIDDLE INCOME HOUSEHOLDS IN MALAYSIA

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Abstract: Given the significant amount of food waste generated by households, reducing household food waste is critical to mitigating overall food waste and providing multifaceted benefits for humans and the environment. This study attempts to identify antecedents of food waste among lower-middle-class families in the Malaysian household setting and their barriers to sustainable food waste practices. Fifteen individuals from lower-middle-class Malaysian households were selected by convenience and snowball sampling and were interviewed using semi-structured questions. Four categories of food waste antecedents were identified (over-preparing, over-buying, dietary transition, and improper storage). The findings also led to the development of four themes that defined the barriers participants faced to minimising food waste (inadequate regulations and policy, lack of time, lack of education and awareness on food wastage, and lack of appropriate facilities). The findings from this study have important sociocultural implications for future studies, and they also add to our current understanding and application of how to reduce food waste in Malaysian households. More study is needed to find ways to test new ideas and interventions that could reduce household food waste, especially in Malaysia.

Keywords: Antecedents, barriers, food waste, households, lower-middle income.

Abbreviations: Sustainable Development Goals (SDGs), Secondary Shelf Life (SSL)

Introduction

There is a widespread agreement among world leaders that food waste is a serious problem with far-reaching economic, environmental, and social consequences. By 2030, the United Nation (UN) aim for responsible consumption and production and wants the world to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses (Nations, 2015).

Most local governments in Malaysia spend 60 – 70% of their annual budgets on sending food waste and other municipal solid waste to landfills. According to Jereme, Siwar, Begum, and Talib (2021), Malaysia has an ample food surplus. The fact that the first question a Malaysian will ask a friend is "sudah makan?" which translates to "have you eaten?", demonstrates the importance of food in everyday life. Food shopping and eating habits in Malaysian households are influenced by Malaysia's unique cultural and geographical qualities, which distinguish the country from Western countries and play a role in Malaysian's cuisine. Traditional markets, mass-merchandising supermarkets, and retail stores are only some of the many types of food-purchasing options available in Malaysia, which is a good example of how diverse and convenient these options can be.

Despite the incredible variety of foods available, it is terrible that the community still maintains a wasteful attitude about food and that this waste has become a regular habit (Hashim *et al.,* 2021). It is found that Malaysians have generated 16,688 tons of food waste per day which is enough to feed 2.2 million people for three-time meals per day (Saalah *et al.,* 2020). Solid Waste Management and Public Cleansing

Cooperation (SWCorp) forecasted that at the end of 2020, the total amount of food waste generated will be enough to fill 16 of Malaysia's Petronas Twin Towers which is 451.9 meters tall (Saalah *et al.*, 2020). According to Vermeulen *et al*. (2020), achieving Sustainable Development Goals (SDGs) such as zero hunger (SDG2) and keeping climate change under 2°C (SDG13) requires not only greater food security among the poor or marginalised people but also a shift in wealthy people's consumption patterns toward greater sustainability (SDG12).

Household food waste accounts for a sizable portion of the global food waste problem, which has its roots in modern lifestyle choices, the speed with which industry has developed, the proliferation of ready-to-eat foods, and the prevalence of a consumerist mentality. People's emotional connection to food is likely to have changed due to the many changes in the socio-economic and demographic composition of families, as well as in their eating and cooking habits and the types of foods they eat. Many people do not attach any emotional significance to food, so they throw it away without a second thought. The significance of preparing meals together as a family or eating together as a group has been lost to some people, and as a result, food is no longer used as a way to socialise with other people (Gregersen & Gillath, 2020). Scholarly interest in the factors contributing to or causing widespread food waste in homes is rising. Researchers have examined demographic data, specifically age, income, and household count. The amount of food that is thrown out is influenced by environmental factors. Behavioural changes associated with increased food waste awareness are hypothesised. Relationships to food waste can be seen in factors including the way of life, shopping habits, emotional role, consumer values, and societal standards (Apolonio, 2020).

Furthermore, as mentioned by Kowlesser (2020), inadequate official support and a lack of available technical and financial resources further complicate efforts to establish a workable food waste management system. Due to a lack of knowledge about the negative health and environmental effects of waste, illegal dumping and burning are typical practices among households. Therefore, managing and eliminating food waste is a crucial aspect of food chain responsibility and sustainability programs.

This study is relevant for a few reasons. The majority of food waste originates from homes. In addition to being the final link in the supply chain, households are an essential target for food waste reduction initiatives. However, according to Stancu *et al.* (2016), evidence on why consumer-generated food waste occurs remains vague. There is a paucity of research concerning consumer-generated food waste, especially in the context of private households with most studies being carried out in the United States, United Kingdom, Finland, and Denmark (Hall *et al.,* 2009; Williams *et al.,* 2012; Stefan *et al.,* 2013; Graham-Rowe *et al*., 2014; Thyberg & Tonjes, 2016). Despite the rise of studies on the subject, little is known about the underlying factors that encourage and impede food waste practices (Graham-Rowe *et al.,* 2014). Appropriate interventions to reduce household food waste require place-based and spatially sensitive analyses considering the particularities of local food and waste management systems and cultural norms about food. Previous studies have identified several factors that influence food waste in households. However, these factors may vary by geographical and sociocultural contexts. Thus, to fill the gap in the literature, this study explores food waste practices in Malaysian households, particularly among lower-middle-class families, with a specific focus on identifying and exploring the antecedents and barriers to food waste reduction.

Using a qualitative approach, the research relies on semi-structured interviews with fifteen lower-middle-income Malaysian households. Researching the topic from an individual's point of view allows us to get closer to the particular scenario at hand while also considering the local context of food waste in homes. As a result of this research, ideally, policymakers

and the government will better grasp the issue of household food waste and can implement some of the study's helpful recommendations, which are especially relevant in the context of Malaysian families. While the findings from this study are from the Malaysian perspective, the discussion and implications are of interest globally, especially in other developing countries where food waste is also considered a substantive issue.

Literature Review

The problem of food waste is complex and wide-ranging, with many studies having identified various antecedents of household food waste. Food waste takes place in families' daily routine behaviour and activities during shopping, cooking, storing, and eating that they are unaware is interconnected with food waste issues (Hebrok & Boks, 2017). These unacceptable and unrealisable behaviours will greatly impact the whole universe. Xue *et al*. (2017) have claimed that there was a rise in food leftover as individual income increased due to the affordability of purchasing more. Low-income families tend to be more careful about spending because of less purchasing power. However, this statement regarding food waste is contradicted in low-income households. Studies by Porpino *et al.* (2015) found that food waste also happened in lower-income households due to inappropriate behaviour while food stocking, preparation, food consumption, and food storage. Meanwhile, a literature study found that there seems to be a lack of clear understanding between the household income and food waste relationship (Williams *et al.,* 2012; Palatnik *et al.,* 2014).

Antecedents of Household Food Waste

Few factors are identified for household food waste, including consumer behaviours, consumer perception and attitudes, consumer socio-demographic characteristics, household characteristics, food-related characteristics and policy and regulation (Li *et al.,* 2021). Larger households are found to waste more food (Koivupuro *et al.*, 2012), the same holds for higher-income households (Stefan *et al.*, 2013). According to Stancu *et al.* (2016), consumers' report of food waste behaviour was significantly correlated with household size, income, and age. Lower amounts of food waste were associated with older consumers, fewer members in the household and lower income.

Zainal and Hassan (2019) have examined several antecedents of food waste behaviour in a few works of literature and their findings varied. They include several situational characteristics that relate to the portion of food that the households threw away, one's intention, and psycho-social aspects such as cognitive factors and other additional determinants. For example, the awareness and knowledge of food waste as well as habits related to shopping and household planning. Consumer behaviour regarding food and waste is affected to a great extent by the level of knowledge and education one has on these issues. Education, improving awareness, enculturation and mass media significantly reduce food waste (Alibeigi *et al.,* 2011).

Stancu *et al.* (2016) have examined how household food-related routines, skills and psycho-social factors are associated with household food waste behaviour. Findings suggest that food-related routines (i.e., planning, shopping, and leftover reuse) are the main drivers of food waste in addition to perceived behavioural control. Among the routines, the leftover reuse routines were the most important contributors to food waste but were closely followed by shopping routines. Prior literature supports the importance of household food-related routines in understanding food waste behaviour (Koivupuro *et al.,* 2012; Stefan *et al.,* 2013). Perceived behavioural control could also influence the food-related behaviours of consumers, especially food planning routines (e.g., making a food-shopping list and checking food inventories) and shopping routines (e.g., buying too much food and impulsive food shopping) (Stefan *et al.,* 2013).

In food waste related to household waste management (Pakpour *et al.,* 2014), it has been

shown that attitude, perceived behavioural control, intention, moral obligation, self-identity, action planning, and past recycling behaviour were significant predictors of household waste (Schanes *et al.,* 2018). During the COVID-19 pandemic, buyers' physical activities were restricted, and they had to stay home. The time spent online increased, and the food buying pattern shifted to more online purchasing than in the past. The study conducted by Lahath *et al.* (2021) advanced the knowledge of sustainable consumption with the findings on the increased social media usage, neuroticism, and impulse buying that eventually drove food waste during the COVID-19 pandemic. Sustainable Development Goals (SDGs) include no poverty, zero hunger, good health and well-being, responsible consumption and production and other urgent sustainable related issues. The sustainable accumulation of solid waste falls under the responsible consumption and production goals category. To achieve the mentioned sustainable goals, Malaysians must take considerable action in waste separation, mainly to reduce waste accumulation among households.

Barriers to Minimising Food Waste

A study done by Wakefield and Axon (2020) found that insufficient consumer knowledge, action and lack of appropriate waste facilities hindered the ability to carry out sustainable practices at the household level. Similarly, Nunkoo *et al*. (2020) suggested four major barriers to adopting food waste recycling in Mauritius. Space limitations, lack of awareness of food waste recycling, inadequate regulations and policy and lack of time/priority were identified as barriers faced by the households to recycling food waste. According to them, space constraint is believed to be the major barrier to minimising food waste, particularly for those who live in an apartment. On the other hand, a lack of awareness about food waste recycling occurred as many people have insufficient knowledge regarding recycling, composting, and disposing of food waste (Nunkoo *et al*., 2020). Knowledge and information alone do not change behaviours (Axon, 2017). Appropriate information has been reported to promote increased awareness directly associated with reducing food waste (WRAP, 2012). Most of the studies have supported that households' efforts to control food waste behaviours are nearly not possible because many households are lacking in terms of environmental awareness, households' environmental knowledge and government food waste reduction policy (Barr, 2007; Kilbourne & Pickett, 2008; Jereme *et al.,* 2018; Nunkoo *et al.,* 2020).

Other research has shown that the wasteful behaviour of an individual is determined by factors related to current legislation or policy. South Korea is one of the countries that executed the policy to reduce food waste called "Pay as You Trash" (PAYT). The enforcement of this policy had a vital effect on environmental concerns among citizens and reduced the total amount of Municipal Solid Waste (MSW). It is demanding to purchase certified plastic bags for waste disposal for every household. However, recycled bags can be disposed of for free (Zamri *et al.,* 2020). Through this policy, Seoul has successfully cut off its food waste from 3300 tons per day in 2012 to 3181 tons per day in 2014. To successfully implement this program, they have installed a Radio Frequency Identification (RFID) bin to weigh the waste made by each household and assure that they will get their bill accordingly. Also, waste bag prices have increased by 30% since the beginning of 2016 (Zamri *et al.,* 2020). Japan's Food Waste Recycling Law is a policy that was introduced to minimise waste.

Nevertheless, it only applies to the food industry at the moment. Extra hard work is immediately required to reduce and recycle food waste across all stages of the food supply chain, especially at the consumer level (Liu *et al.,* 2016). Many consumers are having a problem with the misinterpretation of date labels as they experienced a lack of understanding and following the instruction to properly store as stated on the label (Canali *et al.,* 2017;

Annunziata *et al*., 2020). Exemption from responsibility occurs when many households give several reasons to ensure they are free from the accountability of producing and dealing with food waste (Nunkoo *et al.,* 2020).

A Conceptual Framework

Based on the research problem analysis and the literature review findings, a framework has been developed. Figure 1 is a conceptual model depicting the relationships between the causes of food waste and the barriers to implementing effective methods for reducing it.

Research Methodology

Participants and Sampling Procedures

Participants (N = 15) across Malaysia were recruited and agreed to participate in this study. Recruitment of participants was supplemented using convenience and snowball sampling techniques to seek participants from lower-middle income groups (B40 and M40). Apart from that, the eligibility criteria for participant selection included having someone responsible for food decisions and familiar with food waste at the household level. The initial data collection phase involved four families, who were recruited with the help of a community leader, who then introduced the researcher to the families. All 15 families came from urban, suburban, and rural areas in Malaysia.

Only women were chosen to be interviewed in the search for eligible participants. Women are believed to spend approximately 85 – 90% of their time on household food preparation and cooking (Koivupuro *et al.,* 2012; Katsarova, 2014). Women tend to be more engaged with household activities such as grocery shopping (Stangherlin & de Barcellos, 2018) and act as nutritional gatekeepers who typically control 72% of the food consumed by their children (Wansink, 2006). It is also known that those with high incomes tend to buy more food than those with lower incomes. People from high-income societies have been identified as contributors to household food waste (Beretta, Stoessel, Baier, & Hellweg, 2013). Without a doubt, COVID-19 has impacted the welfare of Malaysian households unequally, pushing the existing inequalities to the forefront and risking major impacts on economic and social conditions.

Therefore, based on the Household Income and Basic Amenities Survey Report 2019 from the Department of Statistics Malaysia,

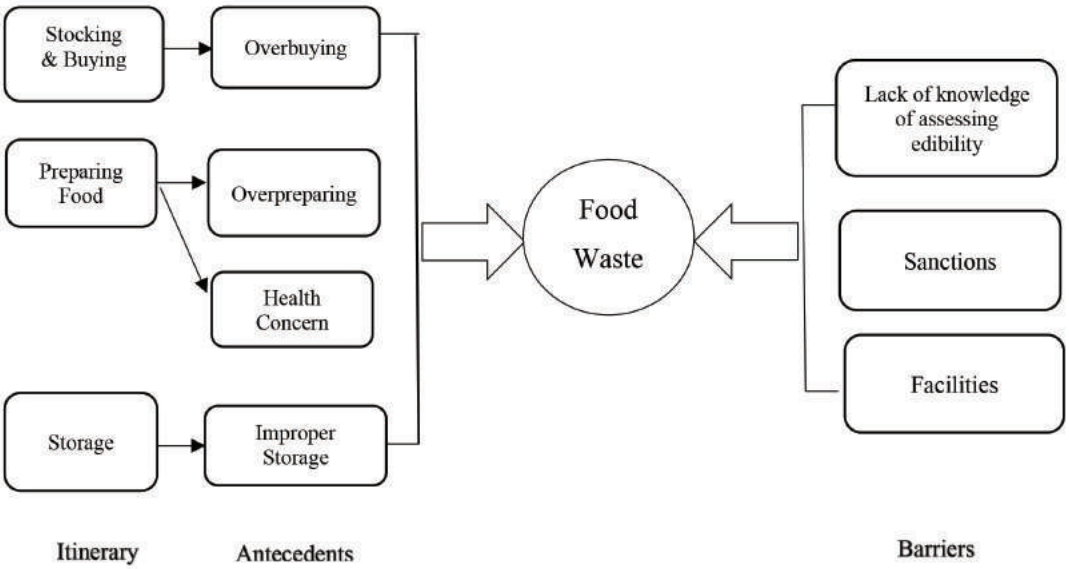

Figure 1: A framework of household food waste: Antecedents and barriers to sustainable food waste practices

participants under the bottom 40% of income earners (B40) and middle 40% of income earners (M40) were selected to partake in this study. The B40 group has been categorised as the lowest household income group, whereby they are measured as a unit that earns a household income of less than MYR 4,850 per month and less than MYR 10,960 per month for M40. Participant characteristics are summarised in Table 1.

Interview Procedure

Semi-structured interview sessions were performed between November and December 2021 at the researcher's office or home. All questions were open-ended and formulated concerning the broad purpose of the study and the existing literature on the topic. The interview questions focused on the participants' general background, understanding of food waste, the causes of food waste, and the challenges they face in recycling food waste. Armed with the research objectives, questions were developed in such a way that it allowed participants to express opinions in their terms and words freely. As the interview progressed, probing questions were added whenever necessary (Saunders *et al.,* 2009). When additional interviews did not provide new information on the thematic concepts (Glaser & Strauss, 2017), the saturation point was reached with the 15th interview. The interviews lasted 45 minutes on average and were tape-recorded (with permission) and transcribed verbatim soon after.

Data Analysis and Interpretation

Interview transcripts were coded using the analytical data procedures of thematic analysis to identify categories underpinning households' beliefs and behaviours about food waste. First, transcripts were read and reread several times to have a broad understanding of the data and to identify any evident trends. This initial 'open' coding was refined as new insights emerged. Second, 'axial' coding was performed by connecting the category and its subcategories (Corbin & Strauss, 1990). Further, following Strauss and Corbin (1990), 'selective' coding was used to show interlinkages between the core categories.

Table 1: Household members' demographics

Code	Role (food related)	Household size	Age	Location	Income classification
P1	Buys/organises/prepares	Couple + 3 kids	58	Suburban	B40
P2	Buys/organises/prepares	Couple +6 kids	50	Suburban	B40
P3	Buys/organises/prepares	Couple + 3 kids	51	Rural	B40
P4	Buys/organises/prepares	Couple + 2 kids	43	Suburban	M40
P5	Organizes/prepares	Couple +2 kids	47	Suburban	B40
P6	Buys/organises/prepares	Mother + 5 kids	37	Rural	B40
P7	Buys/organises/prepares	Couple +1 kid	36	Urban	M40
P8	Buys/organises/prepares	Couple + 4 kids	34	Urban	B40
P9	Buys/organises/prepares	Couple + 2 kids	33	Urban	B40
P10	Organizes/prepares	Couple + 3 kids	29	Urban	B40
P11	Buys/organises/prepares	Couple +5 kids	45	Urban	M40
P12	Buys/organises/prepares	Couple + 3 kids	38	Urban	B40
P13	Organizes/prepares	Couple + 3 kids	43	Urban	M40
P14	Buys/organises/prepares	Mother + 2 kids	54	Suburban	M40
P15	Buys/organises/prepares	Couple + 2 kids	32	Rural	B40

Throughout the analytic process, we adopted the constant comparison method (Glaser & Strauss, 2017). Unique and new instances in the data were compared to existing categories to develop an understanding of the core meanings. Participants expressed their views on food waste antecedents which included: (1) overpreparing; (2) overbuying; (3) dietary transition (more diversified diet); and (4) improper storage. The findings also led to the development of four themes that defined the barriers participants face to recycling food waste: (1) inadequate regulations and policy; (2) lack of time; (3) lack of education and awareness about food wastage; and (4) lack of appropriate facilities.

Research Framework

As outlined in Figure 2, the study was conducted using Qualitative Content Analysis (QCA) which systematically explains the data collected through semi-structured interviews to answer the research questions. The findings were interpreted via a systematic classification process of coding and themes were identified. After a thorough coding of the analysed data, the findings of this study were analysed and compared to those of previous studies using the summative technique of QCA.

Ensuring Rigor, Validity and Reliability in Qualitative Inquiry

Following Merriam and Grenier (2019), this study performed a review process through peer checking and examining to enhance the validity and reliability of the qualitative research. Segments of pertinent and useful data were identified with memos, then initial codes were attributed. Three researchers further read each other's memos and discussed their insights, comparing coding and themes before reaching a consensus on the delivery themes. They focused on the research questions and analysed the transcriptions using a line-by-line open coding procedure. Original data such as recordings and

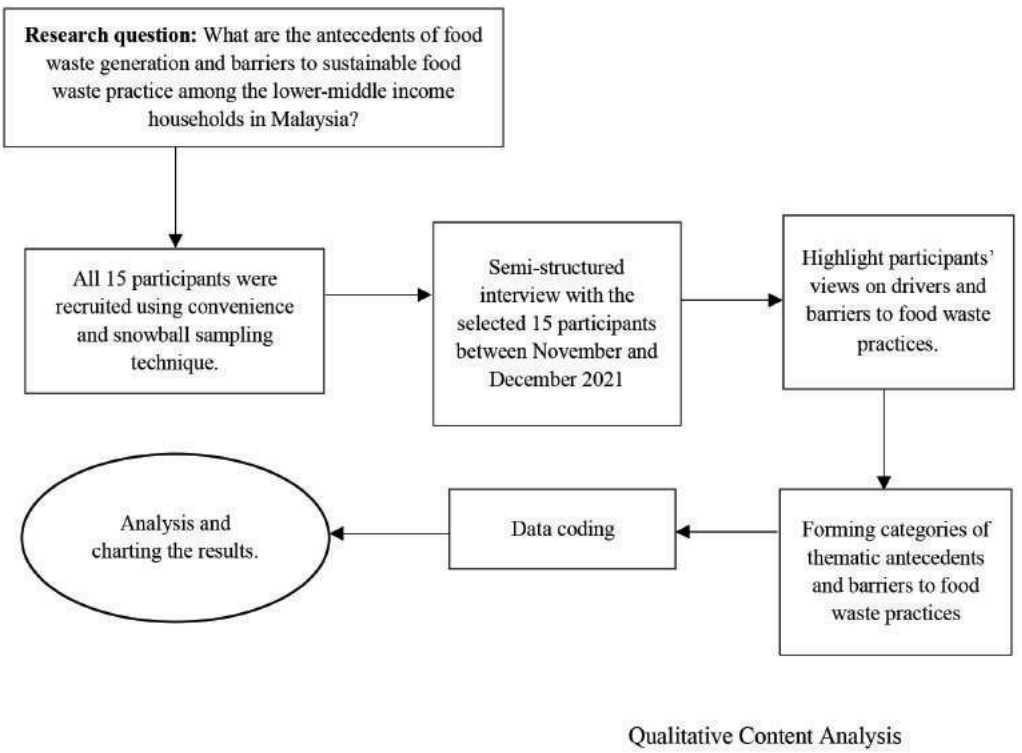

Figure 2: Systematic framework of the research structure. (Source: Author's illustration)

archival data, have been completely utilised during data analysis and presentation to ensure that interpretations of the data gathered were authentic.

Thus, the validity of the qualitative data in this study was ensured through (i) the use of multiple methods of data collection and (ii) the use of multiple researchers' checking to reduce researcher bias (Rose & Johnson, 2020). Furthermore, personal identifiers were removed during transcription to maintain confidentiality, secrecy, and anonymity of participants' identities. A pseudonym was used, with special consideration given to the information obtained. The researchers referred to the participants as P1, P2, P3...P8 to protect the identities of the households involved and to avoid the possibility of pseudonyms being misinterpreted as real subjects. In qualitative research, ensuring credibility, dependability, transferability, and conformability aided in establishing trustworthiness.

Results and Concluding Discussion

Antecedents of Food Waste

All these fifteen mothers reported having wasted leftovers in the week before the interview was conducted. When asked about the major causes of food waste, participants elaborated on several factors that mirrored the findings of the literature review. Surprisingly, they also discussed further aspects of these findings and raised interesting points.

Overpreparing

Families who value abundance on the table might translate the habit into enormous food waste. All participants claimed they preferred to present large servings on the table and ensure plenty of food for everyone. Given that women are mainly responsible for most chores and cooking, this study also observed that the participants chose to prepare from scratch, leading to over-preparation and creating more food waste.

> *"Having plenty of food is important because I want to ensure that the food is enough for everyone. All meals are prepared from scratch and fresh products, especially when it comes to vegetables and seafood. My husband and I don't like processed food. However, I found it very difficult not to be over-prepared. Guess it's just a habit to have plenty of food on the table, even if they don't eat and are dumped out of sight." (P8)*

In the context of "eating properly", these comments further support the findings that demand for cooking a variety of meals from scratch and fresh products might cause over-preparation, a key antecedent of household food waste (Evans, 2012; Graham-Howe *et al.,* 2014; Porpino *et al.*, 2015; Stancu *et al.,* 2016; Stangherlin & de Barcellos, 2018; Principato *et al.,* 2021). When explaining food preparation, participants tend to justify the habit of over-preparing due to practicality and minimising inconvenience, helping them to save more time in the kitchen. These comments support the findings from Porpino *et al.* (2015), as they identified that women in the low-income context in Brazil considered cooking in abundance to save time.

> *"Yeah, nowadays we have busy lifestyles and demanding jobs, so we prefer convenience. I like to prepare a great quantity of food and can save my time from preparing another batch of meals even though I couldn't finish all of it, or else I would be the size of the house." (P10)*

Comfort food, in particular, was found to be stocked in abundance to be eaten as snacks between meals and to ensure psychological comfort. Due to snacking habits, prepared food was not consumed or even stored in the refrigerator because many families claimed they did not prefer to repurpose leftovers, presumably, generating more food waste from

the households. Studies by Stancu *et al.* (2016) and Van Geffen *et al*. (2017) postulated that saving and eating leftovers can prevent food waste. Due to over-preparing, participants who experienced dissatisfaction with food freshness or prejudice against leftovers were deemed as promoting consumer food waste (Porpino *et al*., 2015; Stancu *et al.,* 2016; Stangherlin & de Barcellos, 2018). Participant 11, from her experience, clarified that:

> *"My children graze throughout the day enjoying a never-ending snack time. The only thing about snacking was that they sometimes skipped their meals, leaving prepared food uneaten. Also, I noticed that my children won't eat the leftovers even though I repurpose them the next day. Therefore, whether they eat or not, I won't keep my leftovers in the fridge and make sure I dispose of them before going to sleep." (P11)*

Although the desire not to waste good food or money was a considerable reason for some, so was the desire to be a good parent. The need to feel like a good provider and minimise the sense of guilt if they failed to satisfy personal and or cultural expectations was uttered by some of the participants and this perceived need was normally fulfilled by over-preparation of food. Individuals also appeared to be highly influenced by the desire to provide plenty of food, showing further evidence that food waste practices are associated with the role of the matriarch (Stuart, 2012). Parents, most notably mothers, described the importance of providing abundant food for the family as a symbolic gesture of their abilities to protect and nurture them, even if the food goes straight to the bin. Thus, among participants who could be classified as "caring for the family", they appeared to be of paramount importance when identifying the antecedents behind current food waste practices:

> *"I cook a lot of food because my son doesn't eat spicily and my husband loves to eat curry. I tried a few times to keep the leftovers so that I can heat up and serve them the next day but none of my family likes to eat leftovers. I try to please everyone and make sure that everybody was satisfied." (P12)*

> *"Yes, I admit that I prepare abundant food for my children rather than them choosing to snack on something unhealthy. Sadly, I tend to cook more food than my children would eat. But I don't care too much about the wasted food as long my family don't go to bed hungry." (P2)*

> *"If my kids are having rice for lunch, then I probably make noodles or pasta for dinner, even if they sometimes didn't eat it. I'm not worried too much about the uneaten food that would have otherwise gone to waste. As long I don't feel guilty if my kids have nothing to eat." (P6)*

Having a sense of identity to provide ample food for the people is an important driver of individual behaviour to express who they are and would like to be (Dittmar, 2004). Therefore, echoing Evan's (2012) findings, we found that the desire to be good at providing abundant food for the family, associated with affection and abundance, was a strong antecedent of food waste among lower-middle-income Malaysian households.

Overbuying

Four participants confirmed that their habits of buying food in bulk without properly planning for grocery shopping for the coming week will have generated more food waste. Purchasing items that do not fit into their ordinary meals is why food is forgotten, spoilt, and discarded, which is positively related to underlying causes of surplus food. Others justify the habit of their excessive purchase due to the strict lockdown imposed by the Malaysian Government in March 2020.

> *"Sometimes when I am in the supermarket, I will buy without the real need for it since I do not plan for my grocery. I even forgot that I bought that*

item and sadly many of them already expired in my cabinet. It is comforting to have a pantry or fridge full of food, especially during the lockdown. Since the unexpected event, I tend to purchase more food as a precaution. That might be the reason why the amount of the food purchased seemed to be greater than what I needed." (P11)

For many household food purchasers, the desire for every spot in the pantry to be filled with food shows that people are often misled by their surroundings, which apparently will lead to overbuying and food not being used before it goes bad. From the psychology of food waste, this habit portrays that they dislike spotting any white spaces in their kitchen, and as a consequence, they are driven to overbuy. According to them, the products that usually be bought in abundance are canned food, cookies, bread, and sauces.

"I just love to see my cabinet filled with canned food and cookies. I'm worried about not eating. Knowing that there is food in my cabinets will give me a pleasant feeling. And I don't like to see empty spaces because having plenty of food is important for me, especially when someone comes to your home unexpectedly. At least you can find something to cook and serve them. That's my way." (P3)

"I constantly buy bread in bulk when I do grocery shopping but most of the time, there is always a bunch of them that remains uneaten. Canned food and sauces are my must-buy items when I go grocery shopping. I feel better when I have a ton of food in my pantry." (P14)

Other empirical evidence referred to the tendency to buy a product with discounts. This was supported by Graham-Rowe *et al.* (2014), as they reported that household food purchasers blamed supermarkets for palming off their waste to consumers through special offers, such as "two for the price of one" or prepacked foods, typically fruits and vegetables. The following quotation exemplifies this tendency:

"If we find there are 'Buy-One-Get-One-Free' or 'Buy-Two-Get-One-Free 'deals, we end up buying although we still have it at home. Mostly vegetables and fruits are all pre-packed and oftentimes you can't tell how fresh they are. I think this is how supermarkets use the trick to get rid of their waste." (P15)

These comments further support findings that the habit of overbuying, including buying in bulk and stocking food at home, is responsible for generating more food waste (Cox & Downing, 2007; Stefan *et al.,* 2013; Graham-Rowe *et al.,* 2014; Porpino *et al.,* 2015; Setti *et al.,* 2016; Stangherlin & de Barcellos, 2018; Principato *et al.,* 2021). Relatedly, Stuart (2012) has argued that having food to spare, even for the food that is ever likely to be needed, can sometimes be reassuring. Several studies described that the increased food wastage among the lower income households might result from higher expenditures, with the tendency to patronise warehouses for cheaper bulk purchases (Setti *et al.,* 2016). Inexpensive goods are often viewed as low-quality food, such as having shorter shelf life and poor nutritional value, impeding consumers from their disposal syndrome (Setti *et al.,* 2016).

Dietary Transition

Interestingly, participants 4, 7 and 13 experienced a rapid transition in dietary patterns, accounting for a much greater proportion of perishable foods. The changing consumption patterns will constantly generate more food waste as people eat less starchy food and take more fresh fruits, vegetables, fish, meat, and dairy products. Even some reported having adults with diabetes in families that must adhere to dietary restrictions. As mentioned by one of the participants:

"My husband was diagnosed with diabetes and a non-diabetic spouse

like me needs to learn new diet habits. Since then, he only prefers fruits and vegetables, but I find it very difficult to keep them fresh. Most of the time, they went bad in refrigerators." (P7)

These statements indicate that stockpiling perishable foods is more vulnerable and more likely to be wasted according to their shorter shelf life. In addition, a similar observation was reported by Parfitt *et al.* (2010) and Porpino *et al.* (2015), whereby higher rates of food waste are due to quality diets containing unprocessed foods, including fresh fruits and vegetables.

Improper Storage

Participants 2, 6, 8, 11, and 12 reported that food spoilage at the household level occurred due to improper storage. This finding is in line with few studies as they claimed that proper food storage could decelerate the ageing process and reduce food waste (William *et al.,* 2012; Porpino *et al.,* 2015; Stangherlin & de Barcellos, 2018; Romani *et al.,* 2018; Principato *et al.,* 2021). They experienced a problematic relationship with leftovers as the food was stored for too long in the refrigerator, lost its quality and ended up in the bin. Participant 6 stated she was so forgetful, not remembering that she had food in there until the cleaning day and the leftovers were finally thrown away after a long period.

Besides, high-risk foods, especially those in packages, cans and jars, should be stored and handled correctly. Interestingly, some participants faced difficulty, especially during festive seasons or when expecting guests, as their refrigerators were always packed with these foods and there was no space left for a small container to be stored. According to participant 12:

"We experienced inappropriate storage in the fridge, especially during Hari Raya. For this event, we have many guests coming to our house, so we tend to stockpile food on a large scale. We ended up having many opened canned and tinned food in the fridge. At the end of the day, if I am not uncertain of the use-by-date, I just throw it out." (P12)

The results demonstrated that due to poor storage, food began deteriorating, leading to significant physical and value losses. Not all people prefer the taste of changing or drying food, and this liking caused more food to be discarded. Knowledge of proper storage has proved to help reduce food waste by up to 20% (Principato *et al.,* 2021).

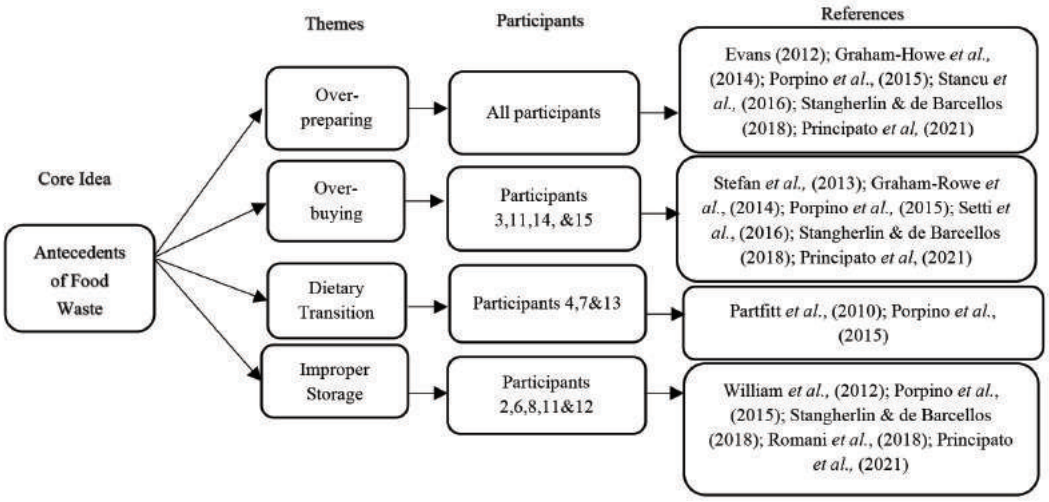

Figure 3: The summary of research finding on antecedents of food waste among lower-middle-income households

Barriers Towards Sustainable Food Waste Practices

The thematic analysis found four barriers towards sustainable food waste practices amongst the households and details are as follows:

Inadequate Regulations and Policy

All participants unanimously agreed that the symptoms of the environmental crisis today were due to the paucity of regulatory frameworks and policy attention for managing food waste in Malaysia. Some of the interpretive codes used to indicate their views were "government do not do enough", "no strict schemes for food waste management", and "not everyone access to food waste bins". Addressing this barrier will likely improve food waste practices (Nunkoo *et al.,* 2020). For example, the government imposes a penalty and fee for households not complying with regulatory provisions or providing subsidies if they handle food waste properly. Well-defined regulations and policies seem to be a more effective apparatus to combat household food waste generation and the findings are similar to prior research of Schanes *et al.* (2018) and Nunkoo *et al.* (2020). Some of the responses are:

> *"I think it is something to do with the national scheme to ensure that every one of us has access to food waste bins. It is more than just a local council job." (P7)*

> *"Maybe the authorities or government can provide us different bins for different types of waste and impose a penalty for not doing it correctly. So far there's just no such thing here." (P11)*

> *"We don't have a strategy to walk on the sustainable pathway. I'm still waiting for our government to come out with stricter policies on food waste management so that I will be more encouraged to compost or recycle. Well, maybe our government don't do enough." (P4)*

Lack of Time

A further barrier to minimising household food waste concerns time constraints in mind. Due to their daily activities, five participants do not pay much attention to food waste, showing a lack of engagement with food waste management at the household level. Some of their responses such as "not have made time", "do not manage to make time", "have more urgent matters to attend to", and "busy with household work", was used to reflect their reasons for lack of time for composting food waste. One of the participants noted that:

> *"I am a working mom and I do not have much time to compost leftovers. I don't bother about the waste I generated from my cooking and guess we are too busy with our work and have other more important things to attend to. It just falls outside our normal day-to-day activities." (P8)*

This comment reflects the findings of Graham-Rowe *et al.* (2014) and Nunkoo *et al.* (2020), who found that lack of time was among the barriers to not adopting household food waste minimisation behaviours.

Lack of Education and Awareness about Food Wastage

Participants portrayed a lack of education and awareness on food waste composting, not knowing sustainable ways to dispose of food waste. "Food waste was not a big problem", "never thought about it", "backyard smells of rotting food", and "not aware of other ways to compost" were interpretative codes mentioned by four participants to explain their lack of awareness on how to carry out sustainable food waste practices confidently.

One participant noted that a composting method she adopted a few months ago seemed ineffective, indicating a lack of education and awareness of the importance of the issue and its viable solutions:

"For the past few months, I tried to compost food waste behind my yard, however, it started to smell of rotting food. I have to be honest with you the rotten smell keeps me awake at night and hence we stopped." (P2)

Other excerpts from the participants were:

"The leftovers are usually fed to our cats and given to the birds, but the remaining is ended up into the bin as I am literally would not sure what to do with them." (P11)

"Frankly speaking I don't give any bad thought to this. I do separate things in their specialised bins but when it comes to food, I just throw it away. I felt Ok as long there are no negative environmental consequences." (P14)

"I know there are food waste management guidelines, but I am uncertain how they work. They are all very vague." (P7)

These statements signify a crucial need for disseminating relevant knowledge and information regarding sustainable food waste practices, especially at the household level. A general lack of education and awareness of food waste has been documented in prior research (Farr-Wharton *et al.,* 2014; Porpino *et al.,* 2015; Nunkoo *et al.,* 2020; Wakefield & Axon, 2020). It has been claimed that this lack of education and awareness may be a consequence of why household food waste is being discarded a bit at a time.

Lack of Appropriate Facilities

A third apparent reason that hindered their ability to carry out a more sustainable approach was the lack of appropriate facilities. "No recycling or compost bins for wastage", "food composting systems are expensive "and "no source separation pickups" were the codes mentioned by four participants to describe the lack of appropriate facilities for food waste recycling. Some of the responses were:

"I currently live in a city apartment, and I do not have any compost bins for wastage." (P7)

"If the municipality can provide source separation pickups, I think it would be much easier for me to recycle food waste and I believe it would be beneficial for all of us." (P14)

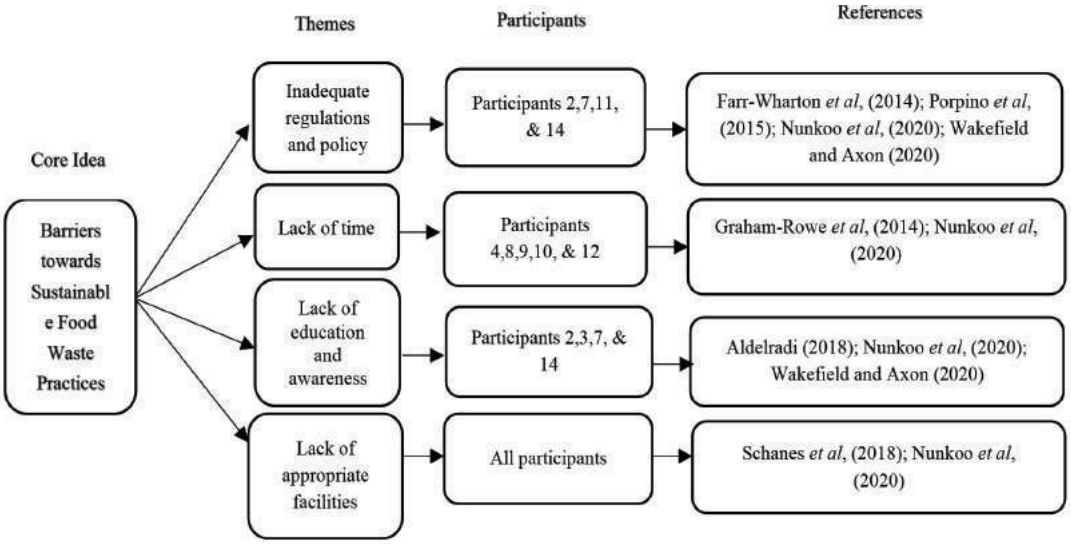

Figure 4: The summary of research findings on barriers towards sustainable food waste practices among lower-middle-income households

Regarding financial concerns, some participants stated that food composting systems are not cheap to maintain, preventing them from recycling food waste. Thus, Abdelradi (2018) has concluded that it is important for the participants to have easy access to food recycling to motivate them to manage food waste more sustainably. These comments indicate that several participants responded negatively to the lack of facilities available to carry out sustainable food waste practices. The finding supports previous research of Abdelradi (2018), Nunkoo *et al.* (2020) and Wakefield and Axon (2020).

Implications of the Research

Our study provides valuable implications for addressing the problem of food waste after explaining the barriers and causes of this trend. To this end, it will be necessary for consumers, companies, and institutions to work together, each playing to their strengths. The following is a list of several policy instruments and interventions that may prove to help reduce food waste at the household level:

(i) The results can be used to develop subjective norms campaigns that emphasise individuals' tendency to conform to the acts or opinions of their peers. According to a recent study by Wunder *et al.* (2019), advertisements that provide information about the behaviour of others have proven to be effective in motivating individuals to reduce food waste.

(ii) A targeted audience (such as families with children, who appear to generate larger amounts of food waste) should be the focus of educational programs to enhance consumers' skills and understanding of food provisioning, cooking, and storage. 'Gerobok Rezeki' is among the charitable food drive that many mosques can adopt and many prestigious educational institutions. The community can reduce food waste thanks to this initiative.

(iii) The findings of this study suggest that the secondary shelf life (SSL) indications policy in Malaysia for consumer products can be significantly expanded or even eliminated. For instance, the extension of the labelled SSL based on its objective assessment would add value to the packaged food product without modifying the ingredients, formulation, or production process in any way. This innovation may increase competitiveness, causing consumers to choose the product with a longer shelf life over similar products with a shorter shelf life after opening. The end user could benefit from extending the food's shelf life after the initial opening, with significant reductions in domestic food waste, reduced household stock turnover, and consequential cost savings. Through the objective evaluation of SSL and its effective communication to the end user, this study can contribute to reducing domestic food waste and the overall sustainability of food chains.

Food waste is also indirectly related to the energy resources used in producing fertilisers and other inputs and distribution, such as the energy used in storing and transporting food. Not only is there a waste of energy when food is thrown away, but there is also a waste of the water used to create the food. The current study by Some *et al.* (2022) have found that reducing food waste reduces energy use/demand (SDG 7), water use/demand (SDG 6) and land use/demand (SDG 15) for food production. Thus, the above-mentioned mitigation strategies not only have synergies with the energy-saving goal (SDG 7) but are also closely linked with awareness and educational programs (SDG 4 and SDG 12), technological solutions/innovation (SDG 9), much broader innovative policy designs (SDG 16) going beyond market incentives, and the participation of numerous social actors (SDG 17). At the level of 17 SDGs, it was evident from the findings that household food waste plans and programs had an impact on the achievement of SDGs, to varying degrees, with the greatest impact appearing in goals related to improving the quality of life and health in cities, as well as addressing climate change, enhancing life on earth, and fostering partnerships.

Limitations and Future Research

The research findings are too general, highlighting Malaysia's lower-middle-income households in comparing food waste. Little is known about the determinants of wasted food in the lower-middle income context. Most published papers consider food waste part of the Municipal solid waste (MSW)'s responsibility. Therefore, searching for articles regarding food waste statistics in Malaysia is difficult.

This study should be conducted in more diverse settings, such as income segments, specific states, and regions. However, due to the context-specific nature of food waste, our findings may be limited in their applicability to other countries. Future researchers can use subjective research methodologies to investigate household food waste in other countries to ensure that location-based characteristics are considered. Insights gained from such studies may help to advance our theoretical understanding of the social and geographical context of household food waste. Besides, the subjectivities inherent in qualitative research, as opposed to quantitative approaches, imply that the results may have been influenced by our personal biases, values, and prior knowledge of the existing literature. Therefore, other researchers must conduct similar studies in Malaysia to validate our themes and findings.

Indeed, not all the intriguing issues could be covered in this study due to time and space constraints. To better understand home food waste and efficient management techniques for food waste reduction, particularly in Malaysia, future research may consider employing a mixed approach integrating qualitative and quantitative methodologies with longitudinal data collection. The fact that just 15 family food providers participated in the interviews for this study may also be a drawback. However, in terms of the sample size of interviewees, earlier research chose comparable or even much smaller numbers of the sample than the present study (e.g., Nunkoo *et al.,* 2021; Wakefield & Axon, 2020). Future research should increase the sample size to include a larger spectrum of Malaysian household perspectives.

Many works of literature focus more on gaining knowledge about the issue than on coming up with remedies. Therefore, more studies should look for ways to put novel theories and interventions that might cut down on family food waste to the test. According to the studies analysed, consumer food waste is an interdisciplinary topic, and interventions should be systemically combined and created with various consumer groups as targets. Future research is advised to determine the expertise and partnerships required to deliver effective interventions. Moreover, researchers can evaluate the added value of involving consumers as code signers of interventions and the role of other food value chain stakeholders in encouraging consumer food waste reductions. As our study chose to focus on other elements due to time and space constraints, we acknowledge that these recommendations for future research are important and will greatly enhance the value of our work.

Conclusions

The study presents empirical findings of four antecedents and four barriers in a lower-middle income context which fulfils our objectives and contributes to previous consumer behaviour studies on food waste, particularly in Malaysia. This is not surprising, given that food waste is a real problem faced by lower-middle income families, and hence this needed to be supplemented by educating them on sustainable food waste practices. It is believed that a minor change in the individual behaviour of this segment will have a considerable impact on society at large.

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